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Behavioral Responses to Risk in Rural China

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Does risk perpetuate poverty in a credit-constrained economy? Income risk appears not to discourage schooling but does inhibit the out-migration of labor. Only a small share of wealth is held in unproductive liquid forms to protect against income risk.

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Summary findings

Does risk perpetuate poverty in a credit-constrained economy?

Jalan and Ravallion study portfolio and other behavioral responses to measured risk using household panel data for rural China.

One-quarter of wealth is held in unproductive liquid forms. But only a small share of this appears to be a precaution against income risk.

The authors estimate that eliminating income risk would reduce the share of wealth held in liquid form by less than 1 percentage point. Moreover, that effect is confined largely to middle-income groups; high-income households do not, it seems, need to hold unproductive cautionary wealth, and the poor probably cannot afford to do so.

The authors find no evidence that income risk discourages schooling, but risk does inhibit the out-migration of labor.

Generally, the results provide only limited support for the idea that uninsured risks promote unproductive portfolio behavior in this setting. There is such an effect, but it is small in magnitude and cannot be deemed an important cause of poverty.

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Behavioral Responses to Risk in Rural China

Jyotsna Jalan and Martin Ravallion[1]

World Bank

Does risk perpetuate poverty in a credit-constrained economy? We study portfolio and other behavioral responses to measured risk in household panel data for rural China. One quarter of wealth is held in unproductive liquid forms. But only a small share of this appears to be a precaution against income risk. We estimate that eliminating income risk would only reduce the share of wealth held in liquid form by less than one percentage point. Furthermore, this effect is largely confined to middle income groups; high-income households do not, it seems, need to hold unproductive precautionary wealth, and the poor probably cannot afford to do so. We find no evidence that income risk discourages schooling. However risk inhibits the out migration of labor.

Keywords: Insurance; precautionary wealth; poverty

JEL classification: D91, Q12

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1. Introduction

As a stylized fact, there is great uncertainty about incomes and health in underdeveloped rural economies, and the instruments to insure against those risks are weak or absent. At the same time, there is pervasive poverty. Are these features of poor rural economies causally connected? In particular, does risk promote forms of rational behavior which help perpetuate poverty?

One way that risk might create poverty is by inducing poor credit-constrained households to hold high levels of relatively unproductive liquid wealth.[2] If borrowing is not an option when there is a sudden drop in income, then liquid wealth will be needed to protect consumption. Famously, Keynes (1973, p.170) identified a "precautionary motive" as "..the desire for security as to the future cash equivalent of a certain proportion of total resources". Less famously, he also believed that India was "..a country impoverished by a preference for liquidity" which stifled the "growth of real wealth" (Keynes, 1973, p.337).[3]

The idea that (rational) portfolio behavior in the presence of uninsured risk can help perpetuate poverty appears to be longstanding. It can be found in relatively early writings on

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[2] Strictly, borrowing constraints are not necessary for precautionary saving. If the marginal utility of current consumption is a convex function of consumption then (by Jensen's inequality) a mean-preserving increase in uncertainty about future incomes will increase the marginal utility of future consumption; current savings will rise to preserve intertemporal equilibrium even without borrowing constraints (see, for example, Gersovitz, 1988). Such a model does not, however, explain an effect on the composition of wealth holdings; higher risk will encourage higher saving, but it can be in any form. Nor is precautionary saving the only way in which risk can create poverty. Another is via effects on production decisions; for example, outmoded agricultural technologies may persist because they are less risky (see, for example, Morduch, 1995).

[3] It is not at all clear from Keynes (1973) what his own views on the causes of poverty in India were based on. In his biography of Keynes, Skidelsky (1983, p. 176) writes that, "although he was to write and advise extensively on Indian affairs, the furthest east he ever got was Egypt; the only Indians he ever met were at Cambridge or London; the only books he ever read on India were specialized tomes on finance".

finance and development (such as Patrick, 1966) as well as recent discussions (World Bank, 1998), and emerges in more formal terms in the Bencivenga and Smith (1991) model of endogenous growth with multiple assets. The idea has also been seen to strengthen the case for public efforts to promote better institutions for financial intermediation in poor rural economies.

The plausibility of the claim that precautionary portfolio behavior can cause poverty is not self-evident, however. One can readily agree that there are benefits to poor people from self-insurance; they are likely to be more credit constrained, and (possibly) more averse to risk and more exposed to it. But there are costs too, and arguably the poor will not be able to afford to hold a large share of their wealth in unproductive forms. Poverty is surely a strong inducement to assuring that one's own resources are not idle. Adequate insurance may still be possible by holding only moderately liquid but still relatively productive forms of wealth.

This paper aims to contribute to knowledge about behavioral responses to risk in poor rural economies and the role this might play in perpetuating poverty. Formal economic models of saving behavior have only recently begun to systematically incorporate uncertainty.[4] A new body of microeconometric work using data from underdeveloped agrarian economies has looked for effects of rainfall variability and other income risks on the flow of consumption or savings (including asset transactions), or on growth rates of consumption.[5] However, as Keynes argued,

[4] Contributions include Zeldes (1989), Caballero (1990), Kimball (1990), Carroll (1992, 1997) and Deaton (1991, 1992).

[5] For surveys of past research on risk and savings in developing countries see Gersovitz (1988), Alderman and Paxson (1992) and Besley (1995). Empirical studies of the effect of income risk or variability on savings behavior (including asset transactions) in poor rural economies include Paxson (1992), Rosenzweig and Binswanger (1993), Rosenzweig and Wolpin (1993), Alderman (1996), Dercon (1998) and Fafchamps, Udry and Czukas (1998). Carroll and Samwick (1997) review recent research on

and has since been formalized in theories of demand for money balances when the future interest rate is uncertain (following Tobin, 1958), it is the stock of their liquid wealth which protects people from risk, not the flow into wealth as such. So instead of looking for effects of risk on the flows of savings or consumption, this paper tests directly for portfolio effects of risk. In particular, we test whether those households facing higher idiosyncratic risk to their incomes tend to hold a higher share of their wealth in unproductive liquid form than one would expect given their permanent income and other characteristics. We also test for other potentially costly responses to risk.

The setting for our empirical work is rural areas of southwest and southern China.[6] Our data cover a period (1985-90) after reforms began which entailed abandoning the old commune system of agricultural production in favor of allowing individual farmers the freedom to make their own production choices. Previous research found considerable vulnerability to idiosyncratic risk in this setting (Jalan and Ravallion, 1998a). So an aggregate (village- or area-wide) measure of risk, such as rainfall, is unlikely to provide a good estimate of individual income risk. Here we use instead the household-specific income process over time to identify income risk, following Carroll and Samwick (1997). We extend this method by controlling for any persistence in the errors of the income process.

We find that the share of wealth held in liquid form has a severely skewed and kurtotic distribution, and that this non-normality persists after controlling for a broad set of household

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precautionary saving in developed countries.

[6] For a comprehensive overview of what is currently known about household savings behavior in China see Kraay (1997).

characteristics. With such heavy tails in the distribution, standard estimation methods found in the literature will not be robust. To assure that our analysis of responses to risk is robust to the non-normality, we apply recent advances in quantile regression methods.

We also allow for two other sources of risk that we expect to be important in this setting, namely the variability of foodgrain yields on the household's own farm, and a measure of medical risk. Transport and transaction costs in this setting could mean that risks to own-farm food output matter independently of their implications for overall income risk. Health risk could well entail large increases in medical spending which would influence savings. There has been work on the effects of such health risks on precautionary saving for developed countries, though no behavioral responses have been identified.[7]

There is a further issue of how "liquid wealth" should be defined in a poor rural economy. One might focus solely on money balances (cash in hand). However, a foodgrain stock can also be a good hedge, as has been recognized in the literature.[8] So we define liquid wealth as grain stock plus cash in hand. In defining total wealth we exclude land, which is mainly allocated administratively in rural China; since the market is very thin, valuation is impossible. Non-liquid wealth includes bank deposits, farm capital, livestock, housing and consumer durables.

Besides holding liquid wealth, we examine two other ways in which households might protect themselves from risk in this setting, namely by not sending their children to school and

[7] We refer to the work of Hubbard, Skinner and Zeldes (1994), who find no effect of health risk on savings using U.S. data.

[8] See, for example, Patrick (1966). There is recent supportive evidence on the precautionary role of foodgrain stocks from Park's (1995) surveys in poor areas of northwest China.

by temporary out migration of family labor (which, though restricted in the past, is becoming more common in China). One could make theoretical arguments either way about how risk affects these variables. Consider labor export. Greater income uncertainty might encourage out migration as a risk diversification strategy (as argued in, for example, Rosenzweig, 1988). Alternatively, when rural labor markets are thin, risk can discourage migration, due to concerns about possible labor shortage on the farm. This is plausible in rural China, given that farm labor markets are also thin or non-existent. A labor surplus on average is not then sufficient for out migration – the family will also take account of the variability in demand for family labor. Consider schooling instead. It has been argued that income risk discourages investment in human capital, though there is little evidence.[9] Again the effect could go either way. On the one hand, keeping kids in school may expose the family to higher risk of family labor shortage, but (on the other hand) better educated children could be expected to directly reduce future income risk.

The next section outlines our test for risk effects on liquid wealth holding. Section 3 describes our data, while section 4 presents our results. Conclusions are in section 5.

2. Modeling behavioral responses to risk

It will help motivate our empirical analysis to begin by considering a simple theoretical model of a farm-household's choice between holding liquid wealth and investing in a risky production activity.

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[9] The only study we know of is Jacoby and Skoufias (1997), who find seasonal effects on schooling of income risk in semi-arid areas of India.

2.1 *A model of precautionary wealth*

Consider a household facing a two-period decision on how to allocate its initial wealth W between current consumption, investing an amount K in a risky production activity, and holding an amount M of an unproductive but secure liquid asset. Utility at any date is a strictly increasing and concave function of consumption at that date, and goes to minus infinity as consumption goes to zero. Utility in the first period is $U(W\text{-}K\text{-}M)$. Output in the second period is $F(K, \xi)$ where F is increasing and non-convex in K but also depends on the realization of a random variable ξ. The value of $F(K, \xi)$ exceeds K for at least some values of ξ. $F(K, \xi)$ is also assumed to fall to zero (a total crop failure, for example) for some values of ξ irrespective of the value of K. These conditions assure that there will be positive investment in the risky activity, but that at least some liquid wealth will also be held as insurance (for otherwise there is a positive probability of zero consumption, which gives infinite disutility). The choice of K and M maximizes expected utility:

$$U(W-K-M) + E_{\xi}U[F(K,\xi)+M] \tag{1}$$

Since our assumptions imply interior solutions for K and M these must satisfy:

$$\begin{aligned} U'(W-K-M) &= E_{\xi}U'[F(K,\xi)+M] \\ &= E_{\xi}U'[F(K,\xi)+M]F_K(K,\xi) \end{aligned} \tag{2}$$

The choice of M and K will depend on W and the properties of the distribution of ξ. On differentiating (2) with respect to W and exploiting the second-order conditions it is readily verified that M will be a strictly increasing function of W if and only if:

$$E_{\xi}[U'(F+M)F_{KK} + U''(F+M)(F_{K}-1)F_{K}] < 0 \tag{3}$$

A sufficient condition is that $F_K > 1$ for all ξ. This must hold for some ξ since $F(K)>K$, but it may not hold at all values. Nonetheless, the inequality in (3) is not a strong assumption, and it implies that it will be the poorest (in terms of W) who hold the lowest amount of liquid wealth at any given level of risk. So this model must make one immediately skeptical of any claim that precautionary liquidity preference is largely confined to the poor.

To give a tractable example with an explicit solution for this model, suppose that there are two possible outcomes in the second period: either the investment fails to produce anything or it succeeds, with a rate of return $r>0$. Suppose also that individuals hold logarithmic utility functions. Then M and K maximize $ln(W-K-M)+p.lnM+(1-p).ln[(1+r)K+M]$ where p is the (positive) probability of failure. It is readily verified that the solution for M is $p(1+1/r)W/2$ which is strictly increasing in both W and p, and decreasing in r. Notice that not only do the poorest (in terms of W) hold the lowest amount of liquid wealth at any given level of risk and rate of return, but their demand for this form of wealth is least responsive to risk (since $\partial M/\partial p$ is increasing in W). Total wealth carried over is $W/2$ and the share of it held in liquid form ($M/(M+K)$) is $p(1+1/r)/4$. For example, with a 25% rate of return and a 20% chance of failure, one quarter of wealth will be held in liquid form.

This model could be extended in any number of ways. For example, one could easily introduce transaction costs which are decreasing in M, implying both a "transactions motive" and "precautionary motive" for liquidity. Heterogeneity can be readily introduced by allowing for a vector of household characteristics that influence either the utility function or the production function. At high levels of initial wealth one might also conjecture that the above model will become less relevant, since more efficient means of insurance will probably become available. To sketch an extended version of the above model which incorporates an alternative insurance instrument, let us assume that crop insurance is offered to any farmer who is willing to pay some positive minimum premium in the first period, sufficient to cover a fixed administrative cost and the insurer's expected payout in the second period. Beyond some critical initial wealth (sufficient to afford the crop insurance), this option will start to be the preferred method of insurance because its payouts are state contingent. Thus one can expect that demand for liquid wealth as insurance will initially rise with wealth, but then fall after some point.

2.2 *Method of testing for precautionary responses to risk*

To implement an empirical test for precautionary behavior we must find a measure of the income risk facing the household. Here we follow Carroll and Samwick (1997) in basing that measure on the estimated innovation errors from an income process of the following form:

$$lnY_{it} = \alpha + X_{it}'\beta + \varepsilon_{it} \tag{4}$$

where Y_{it} is the income of household i in time t, and X_{it} is a vector of exogenous variables. The error structure is assumed to be:

$$\varepsilon_{it} = \eta_i + \nu_{it} \tag{5}$$

where η_i is a random individual component with mean zero and variance σ_η^2.

In the standard error component model, the errors are only correlated over time through the individual specific effect η_i. The v_{it}'s are assumed to be i.i.d. random variables. However, for a variable like income it is quite possible that an unobserved shock in the current period will affect the behavioral relationship in at least the next period if not more. The persistence in the errors of the income process over time implies that simply using the variance of the estimated v_{it}'s as the income uncertainty measure will understate the total income risk. In order to estimate precautionary savings, we need the variance of an i.i.d process.

We assume that the random variable v_{it} is an AR(1) process:

$$v_{it} = \rho v_{it-1} + \omega_{it} \tag{6}$$

where ρ (with $|\rho| < 1$) is the serial correlation coefficient and ω_{it} is a random i.i.d. error with mean zero and variance σ_ω^2. Ignoring the serial correlation will still give consistent estimates of the regression coefficients, but the standard errors will be biased which will bias our estimate for income uncertainty. The explanatory variables are assumed to be orthogonal to η_i and ω_{it}, i.e.,

$$E(X_{it}'\eta_i) = E(X_{it}'\omega_{it}) = E(\eta_i'\omega_{it}) = 0 \tag{7}$$

We first test for $\rho = 0$ using the Bhargava, Franzini and Narendranathan (1982) generalized Durbin-Watson statistic (d_ρ).[10] Provided we reject the null that $\rho = 0$, we transform the usual

[10] The test statistic is:

$$d_\rho = \sum_{i=1}^{N} \sum_{t=2}^{T} (\hat{u}_{it} - \hat{u}_{it-1})^2 / \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{u}_{it}^2$$

AR(1) model into a serially uncorrelated regression with independent observations using the Prais-Winsten transformation. Thus the transformed regression disturbances are:

$$\varepsilon^* = (I_N \otimes C)\varepsilon = (I_N \otimes C e_T)\eta + (I_N \otimes C)\nu \tag{8}$$

where e_T is a T vector of ones, $\eta' = (\eta_1, \eta_2, \ldots, \eta_N)$, and $\nu' = (\nu_{11}, \ldots, \nu_{1T}, \ldots, \nu_{N1}, \ldots, \nu_{NT})$. The C matrix is given by:

$$C = \begin{bmatrix} (1-\rho^2)^{1/2} & 0 & 0 & \ldots & 0 & 0 & 0 \\ -\rho & 1 & 0 & \ldots & 0 & 0 & 0 \\ . & . & . & \ldots & . & . & \\ . & . & . & \ldots & . & . & . \\ 0 & 0 & 0 & \ldots & -\rho & 1 & 0 \\ 0 & 0 & 0 & \ldots & 0 & -\rho & 1 \end{bmatrix}$$

We get an estimate of ρ using the relationship $\rho_d = 1 - d_\rho/2$ and the fact that:[11]

$$E(\rho_d) = 1 - \frac{(1-\rho)(T-1)}{[T - \frac{1+\rho}{1-\rho} + \frac{2\rho(1-\rho^T)}{T(1-\rho)^2}]} \tag{9}$$

which can be solved by standard nonlinear numerical methods.

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where $\hat{u}_{it}$'s are the residuals from a least squares regression with individual dummy variables of equation (1). The null of no serial correlation is rejected in the data if d_ρ is significantly different from 2.

[11] See Baltagi and Li (1991) and Wansbeek and Kapteyn (1982, 1983) for further details on this transformation.

Having estimated equation (4), we construct a household-specific income uncertainty term as the variance of the estimated innovation errors in (6):

$$\hat{\sigma}^2_{i,y} = \sum_{t=1}^{T} (\omega_{it} - \bar{\omega})^2 / T \tag{10}$$

We also measure household permanent income by

$$lnY_i^P = \sum_{t=1}^{T} ln\hat{Y}_{it}/T \tag{11}$$

where $\hat{Y}_{it}$ is the predicted income for household i at date t.[12]

To test for portfolio effects of income risk we estimate an equation of the form:

$$S_{it} = Z_{it}'\pi + \gamma ln\hat{Y}_i^P + \theta[\hat{\sigma}^2_{i,y}/\hat{Y}_i^P] + e_{it} \tag{12}$$

where S_{it} is the share of total wealth which is held in unproductive liquid form (which we term the "liquid wealth share"), Z_{it} is a vector of exogenous variables. (In terms of the theoretical model above, $S=M/(K+M)$.) If households hold higher shares of their wealth in liquid form when they face higher risk then the estimated value of θ will be positive. Notice that in testing for precautionary wealth we control for permanent income and other household characteristics which influence demand for liquid assets, such as for transaction purposes, or via effects on utility or

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[12] Carroll (1997) and Carroll and Samwick (1997) have decomposed total income risk into household-specific permanent and transient components. We choose not to do this decomposition because we have only six observations per household to estimate the two parameters.

production functions. We adopt the same specification as (12) for other behavioral responses to risk, as discussed in the introduction.

One could estimate equation (12) using a standard random effects estimator. However, it is possible that several extreme values are present in wealth data making the error distribution heavy-tailed. Then there are efficiency gains in using least absolute deviation (LAD) or median estimation procedures which are less sensitive to extreme values.[13] Our estimating equation is:

$$S_{it} = Quant_{\delta}(S_{it}|Z_{it}, \hat{Y}_i^P, \hat{\sigma}^2_{i,y}) + e_{\delta it} \tag{13}$$

where

$$Quant_{\delta}(S_{it}|Z_{it}, \hat{Y}_i^P, \hat{\sigma}^2_{i,y}) = Z_{it}^{\prime}\pi_{\delta} + \gamma_{\delta} ln\hat{Y}_i^P + \theta_{\delta}[\hat{\sigma}^2_{i,y}/\hat{Y}_i^P] \tag{14}$$

which is the δ^{th} conditional quantile of S_{it} given the explanatory variables. The LAD estimator is asymptotically normal, facilitating standard asymptotic inference procedures. The standard errors of the parameter estimates are calculated using bootstrapping techniques and so are robust to any general kind of heteroscedasticity that may be present. We test whether the errors from a random effects estimation are non-normal. If the null hypothesis of the errors being normally distributed is rejected, we estimate equation (12) using quantile regression methods. We also test for heterogeneity in wealth-holding behavior by stratifying equation (12) by income group.

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[13] See, Buchinsky (1998) for a survey on quantile regression methods.

3. Data

We use panel data formed from the Rural Household Surveys (RHS) of China's State Statistical Bureau. We use a sample of 6,108 households over the six-year period 1985-90 from four contiguous provinces in southern China, namely Guangdong, Guangxi, Guizhou, and Yunnan. The latter three provinces make up one of the poorest regions in China, while Guangdong is a relatively prosperous coastal province. Financial intermediation in rural areas is also better developed in Guangdong, as is evident in our data from the fact that the sample mean of deposits per capita in Guangdong is about four times higher than in the rest of the sample.[14] The differences between Guangdong and the other three provinces in these and other respects are so marked that our tests will often separate out Guangdong.

The RHS is a well-designed and executed budget survey of a random sample of households drawn from a sample frame spanning rural China (including small-medium towns), and with unusual effort made to reduce non-sampling errors.[15] Sampled households keep a daily record of all transactions, as well as log books on production. Interviewing assistants visit each sampled household every two weeks to check on their progress and collect the data. Checks are made at the county statistical office, with return visits to the households when necessary. The household data are collated with geographic data at the village, county and the province levels.[16] All nominal values have been normalized by 1985 prices.

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[14] Mean deposits in 1990 prices are 77.2 Yuan per capita in Guangdong, versus 21.0, 8.3, and 30.3 in Guangxi, Guixhou and Yunnan respectively.

[15] Chen and Ravallion (1996) describe how the survey was done.

[16] See Jalan and Ravallion (1998b) for details on the geographic data.

The computerized data are annual. So we cannot identify intra-year income risk. In a rural economy one naturally expects there to be seasonality, and (less obviously, but arguably) the extent of risk this induces will vary from place to place. With these data, however, we cannot assess whether there is a precautionary savings response to seasonal income risk.[17]

The income variable includes imputed values for in-kind income from various sources (household production which includes farming, forestry, animal husbandry, handicrafts, etc.). It does not include borrowings from (or loans to) informal and/or formal sources.

For the reasons discussed in the introduction, we define wealth as the sum of cash in hand, grain stock, deposits, value of productive farm assets, housing materials, and consumer durables, but we exclude land. "Unproductive liquid wealth" is defined as cash-in-hand and grain holdings of the household.[18]

We also consider two other variables for which impacts of risk are of potential interest in this setting. One is schooling. We use school enrollment rates as our measure of human capital in the household. That is, we take the number of students between the ages 6-17 years as a ratio of the number of children between the ages 6-17 years as the school enrollment rate of the household. We are unable to break this down further into primary and secondary school enrollment rates at the household level, because we do not know the level at which the students

[17] It cannot be presumed that there will be such a response. Using sub-annual data for semi-arid areas of India, Chaudhuri and Paxson (1993) find no evidence that consumption is affected by seasonal income changes, as distinct from annual changes which do have a significant effect.

[18] Some of the foodgrain stock is productive, namely that held for seeds, but this is likely to be a small proportion.

are enrolled. We only have information on their age and whether they are students or not.[19] Since we do not have data on days of school attendance, we cannot identify any risk effects on the daily attendance rate conditional on enrollment.

We also test for risk effects on the temporary out migration of family labor. This is a potentially important route out of poverty in this setting, although historically labor mobility has been quite restricted in China. Our measure of temporary out-migration is the "labor export ratio", defined as the proportion of adult household members (over 18) who are working out of the township (a local administrative unit comprising many villages) for up to six months of the last year (in which case they are still counted as part of the household in the RHS.).

In estimating (4), the vector X_{it} includes age and age^2 of the household head, household composition, education levels of the household members, occupational dummy variables, both on their own and interacted with age, land holding and its squared value, geographic variables including features of the topography of the communities in which the household resides (say, whether or not the village is in the plains, or hills, or the coastal area, whether it is a minority area etc.), as well as socio-economic characteristics of the county in which the village of the household is located in. (For example, proportion of illiterates in the 15^+ population in the county, the infant mortality rate, access to roads, etc.). A time trend is also included in the model. Table 1 gives the income regression.

For identification of equation (12), we follow Kazarosian (1997) in excluding occupation characteristics, which are assumed to only affect wealth-holding behavior through their effect on

[19] Our sample for the schooling regressions is restricted to households with children aged 6-17.

permanent income and the income risk measure. Thus the vector Z includes all those variables in X except the occupation dummies and their interactions with age.

Our income risk variable will clearly not capture all the risks that matter to households in this setting. Given transaction costs, grain yield uncertainty may well matter independently of its effect on income risk. Health risk is also likely to have an independent effect. So we also include in x two other risk variables which are observed in the data. The first is foodgrain yield risk measured by the variance of the residuals in a regression of grain yield against the same set of variables used in the income regression. The second is a measure of medical risk, namely the variance of the residuals from household expenditure on medicine, medical articles, and medical treatment regressed on the same set of variables used in explaining incomes. In both cases we also allow for serial correlation of the errors, similarly to our measure of income risk discussed in the last section, and in both cases we normalize by the corresponding means.

Table 2 gives descriptive statistics. In addition to the overall sample means we give a regional breakdown between Guangdong and the other three provinces, and we give a breakdown by quintiles of households ranked by predicted permanent income per person.

On average, 26.5% of (non-land) wealth is held as cash or grain.[20] The proportion is slightly lower in Guangdong than in the other three provinces. Our measure of income risk is also lower in Guangdong. It is unclear from this (of course) whether the geographic difference in the extent of both economic and financial development is reflected in a difference in the extent of precautionary wealth. Our estimates of equation (12) may throw further light on this issue.

[20] Productive assets accounted for 16.5% of wealth, housing 44.5%, consumer durables 10.3%, and deposits 2.2%.

There is only a slight decrease in the liquid wealth share as permanent income increases. The income risk measure, by contrast falls steeply as one moves to higher quintiles of permanent income.

The behavior of the medical risk measure in Table 2 makes us suspicious about how good a measure this is. The much higher value in Guangdong is clearly not because Guangdongese people living there face higher medical risk. Similarly the higher values at higher levels of permanent income are not because the health of richer people is more uncertain. Our measure is probably picking up an income effect (even though we have normalized the variance by mean medical spending). While we do not think that a better measure is possible with the data available, these results make us cautious in interpreting the results for the effects of health risk.

4. Results

We computed the skewness and kurtosis measures for the liquid wealth share and the school enrollment rate to check whether the dependent variables that we subsequently use in our model are normally distributed. We found strong evidence that both variables are non-normally distributed.[21] The case for using the more robust LAD estimator (discussed above) for these data is thus compelling. For the labor export ratio, there is a strong a priori case for a non-normal

[21] For the full sample, the skewness and kurtosis measures for the residuals from a random effects regression of liquid wealth share on Z were 0.878 and 4.244 respectively and the associated chi-square normality test has a p-value of less than 0.0001. (Under the null of normality the skewness measure should be zero and the kurtosis measure 3.) For the regression of log wealth per capita on Z they were -1.244 and 11.319, again strongly rejecting normality. Similarly, for the school enrollment rate, the skewness measure is -0.517, the kurtosis measure is 6.276, and the p-value of the chi-square normality test is less than 0.0001. We get very similar patterns for the other categorizations analyzed in the paper.

error term given the censoring. Out migration of labor is rare in all but one of the provinces, namely Guangdong; excluding this province, the average proportion of adults out of the village on work was only 0.7%. However, in Guangdong the sample mean of the labor export ratio (proportion of adults working outside the township) was 5.8% with a standard deviation of 14.6. So we confined that part of the analysis to Guangdong.

4.1 Determinants of the liquid wealth share

Our LAD estimates of equation (12) are given in column 1 of Table 3. We find that higher income uncertainty results in a higher share of wealth being held in unproductive liquid forms. The regression coefficient on the income risk measure implies that eliminating all such risk would reduce the percentage share of wealth held as cash or grain by 0.66%, from 26.5% (Table 2) to 25.8%. So, while the risk effect is highly significant, it is quantitatively small.

Recalling our concerns about the medical risk measure, and noting that both this variable and the farm yield risk measure are insignificant in our estimate of equation (12) (column 1, Table 3), we also re-estimated the model dropping both the medical risk and farm yield risk. The results were quite similar to column 1 of Table 3. The coefficient on income risk rose slightly, to 0.0320 and was still highly significant (t-ratio=5.91). Other coefficients and their standard errors were very similar to Table 3.

Aside from income risk, we find a number of other factors influencing portfolio behavior. There is an inverted U relationship between the liquid wealth share and permanent income, with the predicted liquid wealth share peaking at a log permanent income of 5.90, which is close to the mean (Table 2, last row). So the fact that the poor tend to hold a higher share of their wealth in liquid form (Table 2) is due to other factors correlated with income. Education is clearly one such factor; it can be seen from Table 3, that there are strong effects of education (the omitted proportion of household members with post-secondary schooling). Consider two households, one of which has only illiterate members, while everyone in the other household has secondary schooling. Otherwise they are identical. Then our model predicts that the share of wealth held in unproductive liquid forms will be 8.6 percentage points higher for the illiterate household. This difference dwarfs the effect of eliminating all income risk. The most likely explanation is that better educated households obtain a higher rate of return to their investments.

There is also a strong demographic effect on portfolio behavior. The liquid wealth share falls as household size increases, up to a size of four, and rises after that. There may well be scale economies in demand for liquid wealth up to some point. Younger households tend to hold more liquid wealth, possibly because they are more disposed toward engaging in the emerging opportunities for money-based market transactions in this setting.

Some of the geographic effects are notable. The liquid wealth share is significantly lower in the plains and coastal areas, and higher in the hills and mountains (the latter being the left-out dummy variable). Farm productivity tends naturally to be lower in the hills and mountains. Similarly, agricultural development (as measured by irrigation usage) results in significantly lower share of wealth held in liquid form. There is a consistency to these effects, and they can be interpreted as differences arising from external effects of agricultural development in an area on the returns to private investment.[22] However, they might also reflect any effects of non-farm rural development on the transactions demand for money. That is a plausible interpretation of why we find that higher road density results in a higher share of wealth held in liquid form. There is a highly significant positive trend in the liquid wealth ratio. This might also reflect a rising transactions demand for money balances, as the economy becomes more market oriented.

4.2 Effects of risk on wealth, schooling and out-migration

The second column of Table 3 gives the corresponding regression for total wealth. Here we also find a significant effect of income risk, which accounts for 3.7% of total wealth. So there are two effects of risk on total holding of unproductive liquid wealth, one through the portfolio effect (on the liquid wealth share) and one through an effect on total wealth. Combining the two, it is readily verified from Table 2 and 3 that income risk accounts for about 6.8% of liquid wealth (more precisely the change in the log of liquid wealth if income risk vanished is -0.0676). Roughly half of this (3.1%) is due to the portfolio effect; the rest (3.7%) being due to the total wealth effect. A 6.8% reduction in liquid wealth holding is equivalent to 13.4% of one year's mean permanent income.

It is not clear why we are finding an effect of income risk on total wealth. The answer may be that some of the "non-liquid" components of total wealth also have precautionary value. Within the village or nearby, a household might fairly readily sell (or exchange for foodgrain) a

[22] For a deeper analysis of such effects see Jalan and Ravallion (1998b).

productive asset such as a bullock,[23] or even a consumer durable such as a bicycle. However, most of these other wealth components are clearly productive, so arguably any precautionary value they have would not come at a cost to prospects of escaping poverty.

There is also a positive effect of grain yield risk on total wealth, though the contribution of yield risk is small, accounting for 0.06% of wealth. We find no effects of either the grain yield risk or medical risk on either the composition of the portfolio or on total non-land wealth.

We find no effects of income risk on school enrollments (column 3, Table 3). Our dependent variable may however be too aggregated to reveal this effect; possibly if we had data on days of attendance an effect might be found.

Table 4 gives our results for family labor export (recall that this regression is only run for the Guangdong sample). For this regression we used a censored-conditional quantile estimator (Powell, 1984); we estimate this model at the 85% quantile given that the dependent variable is so heavily censored (as discussed above). We find a sizable negative effect of income risk on out migration. Eliminating all income risk would increase the mean by 5.5% to 8.8%. Clearly income risk is an important impediment to out-migration of labor. We find no effect of farm yield risk, but a small positive effect of the medical risk.

There are a number of other factors influencing out migration. It is less likely in younger families. It increases with average education in the family up to secondary, but then falls. It is also higher for households living in counties with a better educated population, suggesting a spillover effect. It falls as land holding increases up to a high level. (The turning point is at 2.82

[23] On the role of livestock as insurance in poor rural economies see Binswanger and McIntire (1987), Rosenzweig and Wolpin (1993), Dercon (1998) and Fafchamps, Udry and Czukas (1998).

mu per person which is almost three standard deviations above the mean of 1.00.) Migration is more likely from the mountains than the plains, but more likely from the hills than the mountains. And there is a strong positive trend.

4.3 Stratifications by permanent income and region

Table 5 gives the stratification of equation (12) by quintiles of permanent income. We do not reproduce all the regression coefficients (though they are available on request), but only those related to the three risk measures.

We find a strong indication of an inverted U relationship between income and the size of the portfolio response to income risk. The significant effect of income risk on the liquidity of portfolios which is evident in the full sample does not hold amongst either the poorest quintile, or the richest quintile. But is found amongst the middle three quintiles, peaking in the middle quintile.

Low precautionary demand for liquid wealth by the (relatively) rich suggests that they either have access to more efficient forms of insurance or to external assistance, or that they have lower demand for insurance generally. For the poor, low demand for this type of insurance could reflect how costly it is to current consumption, or it may reflect prospects for external assistance in bad times.

The effect of income risk on total wealth also has an inverted U relationship with permanent income (Table 5, lower panel). There is no significant effect for either the bottom quintile or the top quintile. So we find no evidence that income risk leads the poorest quintile of households to hold higher levels of wealth; the effects we find for the sample as a whole are driven entirely by the portfolio behavior of middle income groups.

There is also evidence of an effect of grain yield risk on total wealth holding for the poorest two quintiles (as well as the aforementioned effect on the share held as cash and grain). We also find evidence of an effect of the medical risk variable for the poorest quintile (Table 5).

Table 5 also gives equation (12) separately for Guangdong versus the other three provinces. We see that the income risk effect on the share of wealth held as cash and grain does not hold in Guangdong, but does in the other provinces as a whole. The risk effect on total wealth is found in both regions (lower two rows of Table 5), and the size of this effect is stronger for Guangdong. Note, however, that our measure of income risk is also lower on average in Guangdong (Table 2), such that the share of total wealth attributed to the precautionary motive is about the same (4.2% in Guangdong and 4.0% in the other provinces). So the key regional difference is in the extent to which income risk is reflected in portfolio behavior. The geographic difference in portfolio behavior in response to income risk is consistent with the difference in the extend of financial market development (section 3).

5. Conclusions

We have studied portfolio and other behavioral responses to idiosyncratic risk in rural areas of southwest and southern China – a setting in which credit and insurance markets are poorly developed, and yet there is pervasive uncertainty about future incomes and health.

Our results suggest that only a small share of wealth is held in unproductive liquid forms to protect against income risk. If all income risk were eliminated, the mean share of wealth held in liquid forms would fall from 26.5% to 25.8%. We find that there is an inverted U relationship between the precautionary wealth effect and permanent income, such that neither the poorest quintile nor the richest appear to hold liquid wealth because of income risk; it is the middle income groups that do so. We suspect that the rich do not need to hold precautionary liquid wealth, and the poor cannot afford to do so.

We find some evidence that liquid wealth is also held as a precaution against risk to foodgrain yields (independently of income risk). We find no clear signs of a precautionary response to medical risk, though our measure (based on unexplained fluctuations in medical spending) may be contaminated by income effects on medical spending when sickness occurs.

Schooling and (hence) future incomes appear to be protected from both income and medical risk. However, greater uncertainty about incomes does appear to constrain the temporary out migration of family labor, presumably through risk of family labor shortage. This effect is sizable; in the one sample province in our data set where there is some out migration, eliminating income risk would increase the proportion of the adults temporarily working out of the local area from 6% to 10%.

Taken overall, our results provide only limited support for the idea that uninsured risks promote unproductive portfolio behavior in this setting. There is such an effect, but it is small in magnitude, and cannot be deemed an important cause of poverty.

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Table 1: Income regression

Explanatory variable	Coefficient	t-ratio
Household size (log)	-0.27303	-7.3600
Household size^2 (log)	-0.04901	-4.2480
Cultivated land per capita	0.03134	21.2980
Cultivated land per capita^2	-0.00061	-14.0010
Age of household head	0.29680	80.2400
Age^2 of household head	-0.00482	-46.9470
Age^3 of household head	0.00002	28.2790
Whether farming is main occupation	3.35105	39.8220
Whether industry is main occupation	3.14028	14.7190
Whether working in the government is the main occupation	3.47023	9.6050
Proportion of preschool children in household	-0.39332	-20.4190
Proportion of kids aged 6-11 years	-0.22498	-11.8300
Proportion of kids aged 12-14 years	-0.06495	-2.9560
Proportion of kids aged 15-17 years	0.05507	2.7170
Proportion of illiterates in household	0.07191	3.9900
Proportion of primary school educated in household	0.13976	8.6180
Proportion of secondary school educated in household	0.27382	14.8210
Plains (dummy)	0.15825	17.7020
Hills (dummy)	0.07614	10.8100
Coast (dummy)	0.07333	3.9940
Minority area (dummy)	-0.03594	-4.7330
Revolutionary base area (dummy)	-0.03471	-1.6550
Border area (dummy)	-0.00063	-0.0820
Medical personnel per capita in county	0.01189	12.6010
Cultivated area which is irrigated	0.29761	11.1320
Cultivated area on which fertilizer is used	0.37616	13.8290
Roads per capita in county	0.00011	8.3760
Infant mortality rate in county	-0.00075	-2.5390
Illiterates in 15$^+$ population	-0.00149	-3.1790
Time trend	-0.01594	-9.9310
Constant	0.46976	22.4610
R^2	0.6848	

Notes: The model is estimated using random effects panel data techniques, with a serially dependent error term. The modified Durbin-Watson statistic for the income regression underlying the estimate of the income risk variable is 1.6487 and the first-order serial correlation coefficient is 0.2686. The model also includes interactions between the occupation, age, age^2, age^3. All the variables in the model has been transformed according to the Prais-Winsten transformation to correct for first-order serial correlation.

Table 2: Descriptive statistics

Variable	Full sample	Stratified by region		Stratified by estimated permanent income per person				
		Guangdong	Guangxi, Guizhou & Yunnan	Bottom quintile	20^{th} - 40^{th} percentile	40^{th} - 60^{th} percentile	60^{th} - 80^{th} percentile	Top quintile
Liquid wealth share (cash and grain)	0.2649 (0.152)	0.2304 (0.145)	0.2746 (0.153)	0.2864 (0.160)	0.2776 (0.1512)	0.2731 (0.1510)	0.2625 (0.146)	0.2246 (0.146)
Log of (non-land) wealth per capita	6.5322 (0.707)	6.9265 (0.685)	6.4203 (0.672)	5.8954 (0.579)	6.2768 (0.515)	6.4927 (0.505)	6.7462 (0.493)	7.2498 (0.606)
School enrollment rate	0.5508 (0.445)	0.5613 (0.442)	0.5478 (0.445)	0.5238 (0.423)	0.5654 (0.430)	0.5542 (0.449)	0.5615 (0.452)	0.5491 (0.467)
Income risk (X1000)	0.2148 (0.240)	0.1369 (0.163)	0.2369 (0.253)	0.3446 (0.315)	0.2428 (0.257)	0.2057 (0.208)	0.1591 (0.171)	0.1217 (0.140)
Yield risk	57.1207 (919.89)	44.9769 (355.054)	60.5663 (1024.94)	28.6210 (113.169)	108.3974 (1963.256)	35.2745 (165.256)	38.5520 (223.035)	74.6603 (527.503)
Medical risk	20.4164 (97.391)	42.8038 (178.846)	14.0643 (54.028)	9.2793 (30.172)	11.0484 (37.773)	18.5444 (73.287)	23.2944 (95.714)	39.9149 (173.069)
Log predicted permanent income	5.9770 (0.363)	6.3409 (0.326)	5.8737 (0.302)	5.5019 (0.140)	5.7724 (0.057)	5.9539 (0.051)	6.1473 (0.065)	6.5091 (0.224)

Note: Standard deviations in parentheses.

Table 3: Quantile regressions for wealth holding and school enrollment

	Liquid wealth share		Log of wealth per capita		School enrollment rates	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Risk variables						
Income risk (/1000)	0.0309	5.164	0.1710	10.906	-0.0096	-0.656
Yield risk (x1000)	0.0014	1.055	0.0105	4.733	0.0045	0.924
Medical risk (x1000)	-0.0140	-1.280	0.0210	0.592	-0.0470	-1.399
Other variables						
Permanent income (log)	0.5099	7.368	0.2441	1.304	1.2964	9.211
Permanent income^2 (log)	-0.0432	-7.766	0.0888	5.715	-0.0966	-8.608
Household size (log)	-0.0317	-2.215	-0.1059	-2.321	0.2662	3.211
Household size (log)^2	0.0124	2.893	0.0189	1.317	-0.1267	-5.358
Age of household head	-0.0055	-2.032	-0.0049	-0.993	0.0166	1.623
Age^2 of household head (x100)	0.0136	2.299	0.0037	0.355	-0.0240	-1.138
Age^3 of household head (x100)	0.0010	-2.509	0.0003	0.364	0.0009	0.638
Proportion of pres-school kids in hh	0.0592	6.151	-0.2470	-8.779	-0.4430	-15.610
Proportion of kids 6-11 years in hh	0.0538	5.807	-0.1576	-6.713	-0.6335	-28.219
Proportion of kids 12-14 years in hh	0.0221	1.975	-0.0893	-3.447	-0.4897	-20.597
Proportion of kids 15-17 years in hh	-0.0049	-0.453	-0.0477	-1.599	-0.9351	-38.119
Proportion of illiterates in hh	0.0626	7.547	-0.1051	-3.878	-0.6905	-22.586
Prop of primary school educated	0.0385	6.137	-0.0965	-4.109	-0.5329	-25.747
Prop of secondary school educated	-0.0233	-3.963	-0.0102	-0.350	-0.3701	-15.244
Cultivated land per capita	0.0231	7.216	0.0818	11.628	-0.0250	-3.295
Cultivated land per capita^2	-0.0012	-2.057	-0.0061	-6.164	0.0006	0.270
Geographic variables						
Plains (dummy)	-0.0118	-3.986	0.0671	7.383	-0.0118	-1.621
Hills (dummy)	0.0040	1.313	0.0516	7.869	-0.0043	-0.681
Coast (dummy)	-0.0476	-9.577	-0.0112	-0.659	-0.0049	-0.408
Minority area (dummy)	-0.0070	-3.089	0.0392	6.758	-0.0009	-0.129
Revolutionary base area (dummy)	-0.0245	-3.859	-0.0284	-1.543	-0.0234	-2.245
Border area (dummy)	0.0246	6.762	-0.0014	-0.132	-0.0306	-3.170
Medical personnel per capita	0.0007	3.316	-0.0030	-3.901	-0.0008	-1.463
Irrigation usage on cultivated area	-0.0426	-6.792	0.1554	8.390	-0.0597	-3.278
Fertilizer usage on cultivated area	0.0098	1.782	-0.1355	-8.990	-0.0540	-2.645
Roads per capita (x100)	0.0021	6.332	-0.0096	-9.070	-0.0024	-3.047
Infant mortality rate	0.0003	3.438	0.0024	10.355	0.0007	3.956
Illiterates in the 15$^+$ population (x100)	0.0097	0.734	-0.2200	-6.213	-0.0720	-2.056
Time trend	0.0223	43.440	0.0105	7.006	-0.0099	-7.760
Constant	-1.3246	-6.006	2.0576	3.494	-3.1338	-6.848

Table 4: Censored regression for out migration of labor

	Coefficient	t-statistic
Risk variables		
Income risk (/1000)	-0.1870	-4.295
Yield risk (x1000)	-0.0189	-0.846
Medical risk (x1000)	0.0472	2.249
Other variables		
Permanent income (log)	1.8590	2.020
Permanent income^2	-0.1341	-1.895
Household size (log)	0.0786	0.532
Household size^2	0.0124	0.316
Age of household head	0.0062	0.218
Age^2 of household head	0.0001	0.138
Age^3 of household head	0.0000	-0.449
Proportion of preschool kids in household	-0.3124	-3.630
Proportion of kids 6-11 years in household	-0.2290	-3.369
Proportion of kids 12-14 years in household	0.0056	0.077
Proportion of kids 15-17 in household	0.0194	0.220
Proportion of illiterate members in household	0.1372	2.613
Proportion of primary school educated in household	0.1539	2.918
Proportion of secondary school educated in household	0.3576	7.987
Cultivated land per capita	-0.3091	-8.603
Cultivate land per capita^2	0.0549	5.458
Plains (dummy)	-0.0962	-3.277
Hills (dummy)	0.0651	2.645
Coast (dummy)	-0.0482	-1.820
Revolutionary base area (dummy)	-0.0635	-2.590
Border area (dummy)	-0.0230	-0.711
Medical personnel per capita in the county	-0.0121	-4.026
Cultivated area which is irrigated in the county	0.4019	4.429
Cultivated area on which fertilizers are used	-0.5136	-8.174
Roads per capita in the county	0.0001	1.707
Infant mortality in the county	0.0031	2.289
Illiterates in the 15$^+$ population in the county	-0.0109	-12.588
Time trend	0.0319	7.305
Constant	-6.4215	-2.071

Notes: The above regressions is for Guangdong province only. Censored conditional quantile regression methods have been used (conditional quantile at 0.85) due to heavy censoring of the data.

Table 5: Stratifications by permanent income and region

	Income risk (/1000)	Yield risk (x1000)	Medical risk (x1000)
Dependent variable: ratio of liquid to total wealth			
Bottom quintile	0.0118	0.0329	-0.0419
	(1.139)	(2.116)	(-0.439)
20^{th} - 40^{th} percentile	0.0282	0.0013	0.0795
	(3.050)	(4.622)	(1.775)
40^{th} - 60^{th} percentile	0.0344	0.0371	-0.0420
	(3.287)	(4.640)	(-1.609)
60^{th} - 80^{th} percentile	0.0279	0.0137	-0.0860
	(1.647)	(2.069)	(-5.040)
Top quintile	0.0073	0.0116	0.0253
	(0.433)	(2.435)	(2.607)
Guangdong	-0.0071	0.0144	0.0067
	(-0.462)	(2.458)	(0.403)
Guangxi, Guizhou, Yunnan	0.0343	0.0003	-0.0284
	(6.754)	(1.948)	(-1.490)
Dependent variable: Log of wealth per capita			
Bottom quintile	-0.0006	0.1601	0.5786
	(-0.029)	(2.183)	(3.266)
20^{th} - 40^{th} percentile	0.1599	0.0100	-0.2708
	(4.677)	(2.707)	(-1.898)
40^{th} - 60^{th} percentile	0.1033	0.0108	-0.1067
	(3.047)	(0.160)	(-1.558)
60^{th} - 80^{th} percentile	0.2607	0.0796	0.1702
	(4.298)	(4.048)	(2.683)
Top quintile	-0.0625	0.0538	0.0847
	(-0.748)	(1.831)	(1.234)
Guangdong	0.3045	0.0001	0.0335
	(4.824)	(0.003)	(0.713)
Guangxi, Guizhou, Yunnan	0.1704	0.0034	0.0199
	(9.569)	(2.407)	(0.266)

Notes: Numbers in parentheses are t-statistics.

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